KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2009/2010 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF SCIENCE IN

EDUCATION SCIENCE

COURSE CODE: **CHEM 322**

COURSE TITLE: **METHODS OF STRUCTURAL DETERMINATION**

STREAM: **SESSION VII & IX**

DAY: **TUESDAY**

TIME: **2.00 – 4.00 P.M.**

DATE: **01/12/2009**

INSTRUCTIONS:
Attempt all questions:

Total Marks 70 (Each 17.5 marks)

PLEASE TURN OVER

1. (a) (i) Distinguish between bathochromic shift and hypsochromic shift as used in UV-Visible spectroscopy? Give examples. (3 mks)

(ii) Distinguish between hyperchromic effect and hypochromic effect as used in UV-Visible spectroscopy? Give examples. (3 mks)

(b) The following compounds were irradiated with UV radiation: chloroethane, propanone, 2-butenal and cyanopropane.

(i) Identify all possible transitions that will occur in each molecule. (3 mks)

(ii) Arrange the transitions according to increase in energy. (2.5 mks)

(c) (i) The UV spectrum of 3-buten-2-one in hexane shows absorption maximum at 226 nm in hexane solution. Predict which direction the absorption maximum would shift if the solvent is changed to ethanol? (3 mks)

(ii) Explain why ethanal absorb UV radiation at wavelength of 293 nm and propanone absorbs at a wavelength of 279 nm? (3 mks)

2. (a) (i) Explain the different absorption trends observed in bond stretching of the following bonds: (3 mks)

	C-H	C-C	C-O	C-Cl
Frequency in cm^{-1}	3000	1200	1100	800

(ii) Normal ketone has its C=O stretch vibration at 1715 cm^{-1} while a conjugated one has its frequency between 1675-1680 cm^{-1}. Explain (3 mks)

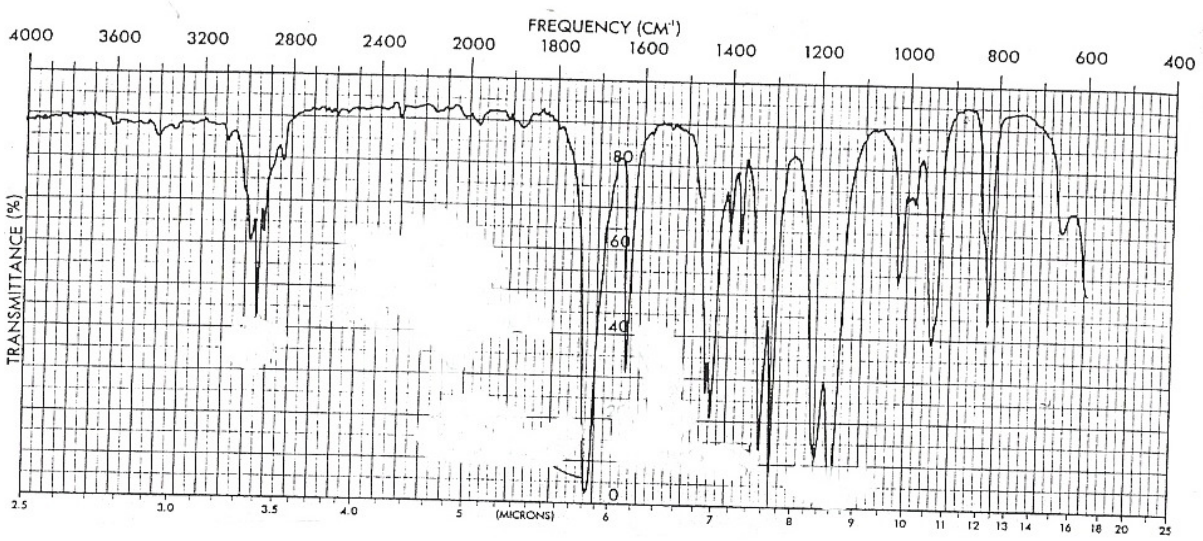
(b) (i) Explain the difference in the frequencies of IR – absorption in C-H bond stretch of the following compounds. (3 mks)

	Alkane C-H	Alkene =C-H	Alkyne ≡C-H
Frequencies cm^{-1}	2900	3100	3300

(ii) Explain the difference in the frequencies of IR – absorption in carbon-carbon stretch of the following compounds. (3 mks)

	Alkene C=C	Alkyne C≡C
Frequencies cm^{-1}	1650	2200

(c) The IR spectrum below is for a molecule with general formula $C_5H_7O_2$. Identify all the functional groups present in the molecule and give the corresponding vibrational frequencies. (5 mks)



3. (a) Describe with aid of a schematic diagram the principle behind mass spectroscopy as a technique for analysis. (6 mks)

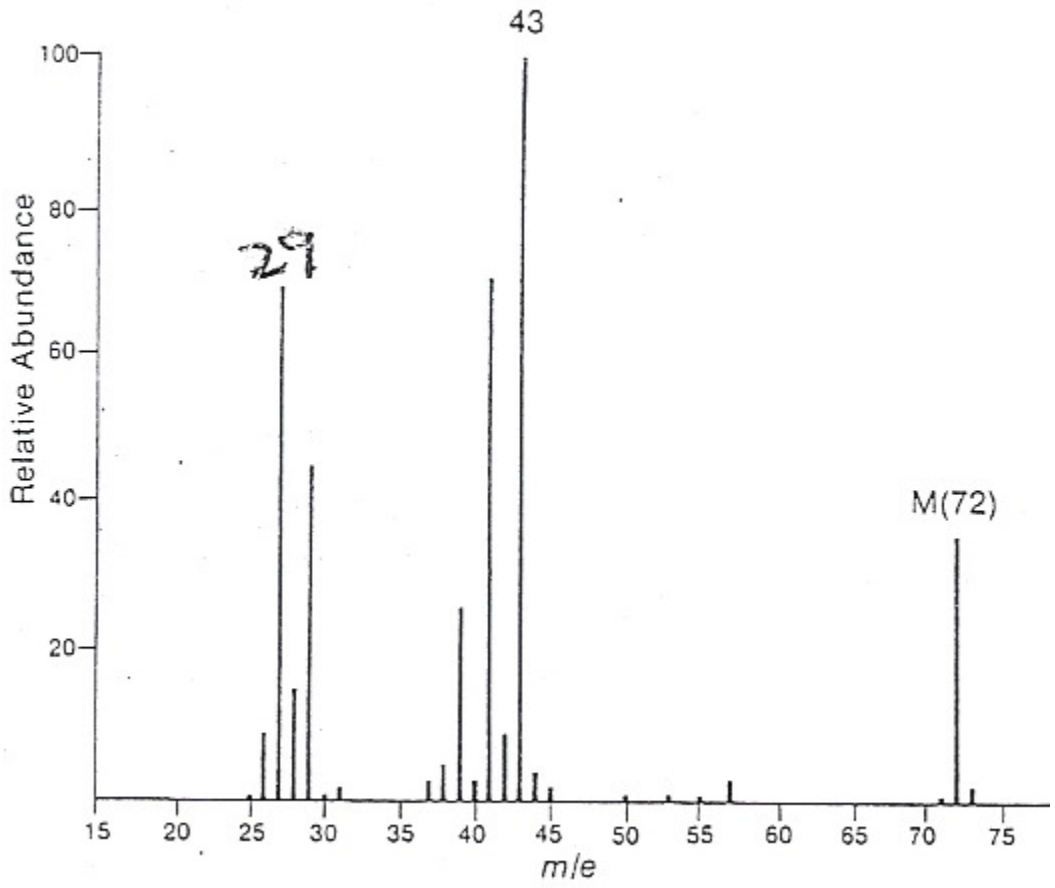
(b) (i) Give all possible fragmentation units of isopropyl benzene that are formed when subjected to mass spectroscopic analysis. (3.5 mks)

(ii) Explain why a strong peak at m/e 105 is observed in the mass spectrum of isopropyl benzene. (2 mks)

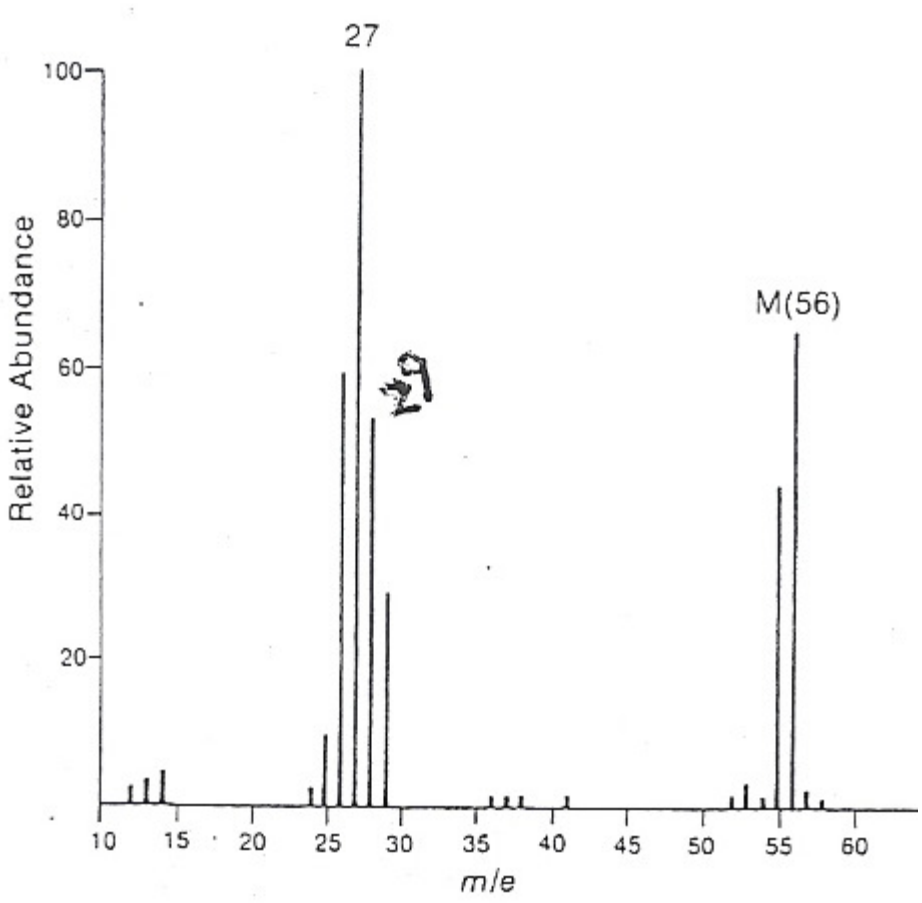
(c) Use the mass spectra below (i) to identify the compound between 2-methyl-propanal and 2-propenal that corresponds to each spectrum. (3 mks)

Assign the fragmentations units for each molecule in question 2 (c) (i) above to their corresponding mass-charge ratio peaks. (3 mks)

Spectrum A



Spectrum B



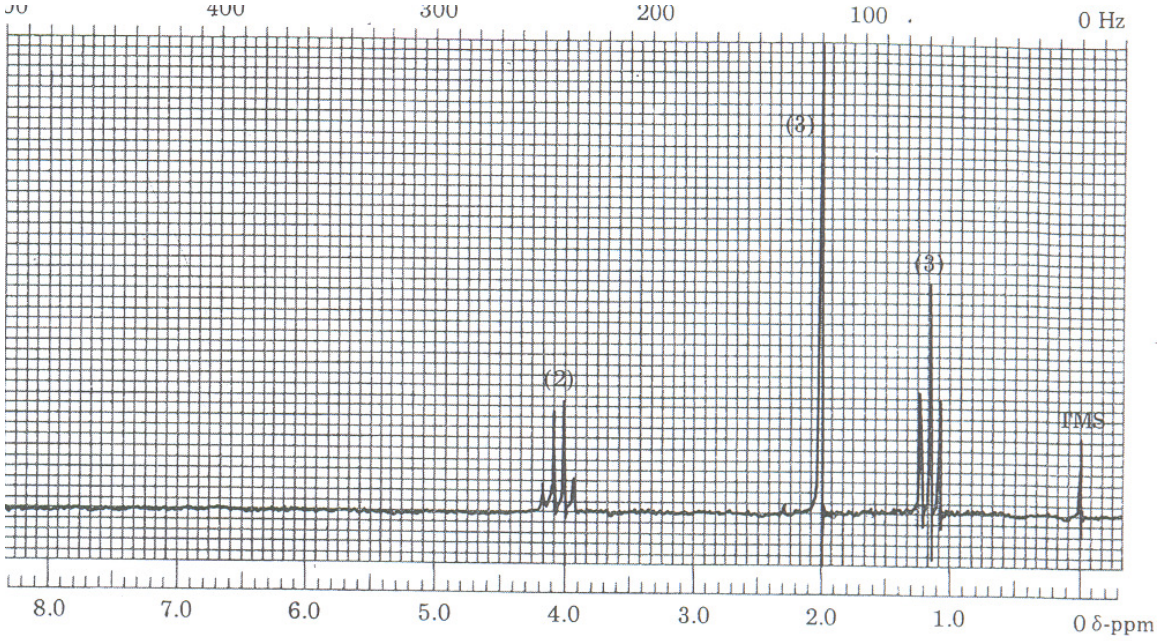
4) (a) Give a flow chart of NMR-spectrometer and explain the functions of magnetic field and radiowave radiation in analysis. (5 mks)

(b) (i) Explain how chemical shift of a proton is affected by electronegativity of an heteroatom adjacent to the proton. (2 mks)

(ii) In benzaldehyde two of the ring protons have resonance at $\delta = 7.72$ and the other three protons have resonance at $\delta = 7.40$. Draw the structure of benzaldehyde and assign the resonance to the corresponding protons. (2 mks)

(iii) Explain the difference in the resonance of the protons in (b) (ii). (2 mks)

(c) The NMR spectrum below is from spectral analysis of an ester with general formula $C_4H_8O_2$ (6.5 mks)



Give the structure of the ester and assign the chemical shift values to the protons giving rise to the peaks.